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SHIPPING TESTS WITH WASHINGTON NAVEL ORANGES UNDER CONTROLLED AND STANDARD VENTILATION AND ICE REFRIGERATION FROM TULARE COUNTY, CALIFORNIA, NOVEMBER AND DECEMBER, SEASON OF 1945-46.

(In cooperation with the California Fruit Growers Exchange)

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INTRODUCTION

The present report deals with shipping tests which were an extension of three series made during December, January, and February, 1944-45, and described in U. S. D. A. Office Report, No. 163, "Shipping Tests with Washington Navel Oranges under Controlled and Standard Ventilation and Ice Refrigeration from Tulare County and Southern California, December, January, and February, 1944-45." The object of the present tests was the same as of the previous ones, and is set forth in the following paragraphs quoted from that report:

> "The purpose of the Washington Navel orange shipping tests reported here was to obtain information on the relative value of standard and controlled ventilation and ice refrigeration; to determine if and to what extent controlled ventilation can be substituted for ice refrigeration; and especially to answer the question whether controlled ventilation can be made practicable, that is to say, whether it is possible to improve ventilation practices to a degree that will allow ventilation to be substituted with safety for ice refrigeration in the shipment of winter oranges from California.
>
> "The expression 'controlled ventilation' is intended to designate an experimental practice of leaving the refrigerator car hatches open either until the outside temperature drops to some point below 32°F. previously agreed upon (thus differing from standard ventilation in which the hatches are closed when the outside air drops to 32°F.), or until arrival at some point en route previously agreed upon, or some combination of the preceeding alternatives."

The introduction of that report carries discussions of the special conditions relating to winter oranges, other tests on controlled ventilation, and winter temperature conditions along the Southern Pacific-Union Pacific route. The reader is referred to that report not only for this material but also for a number of details of methods described therein.

The following notes made from the Summary of this previous report are intended to state briefly the results considered to have been obtained by those shipping tests.

1. Reading of certain critical fruit temperatures in controlled-ventilation cars aided the observers at passing points in the safe handling of the vents.

2. The great amount of heat in a car of warm fruit protected the fruit even in the more exposed positions against dangerous cooling for unexpectedly long periods during sub-freezing weather.

3. When temperatures of the more exposed fruit did become dangerously low, closing the vents resulted in a temperature rise, due to redistribution of the general heat of the load.

4. The rules by which the protective service was operated sometimes resulted in heaters being lighted in standard-ventilation cars while the load temperatures were still 55° to 65°F.

5. Cooling of the loads accomplished by controlled ventilation was generally intermediate between that accomplished by standard ventilation and by ice refrigeration, but somewhat closer to the latter. However, in the February series of tests over the Santa Fe route from Southern California all controlled-ventilation cars showed better cooling than either the standard-ventilation or ice-refrigerated cars.

6. In ice refrigeration it was indicated that (a) rule 240 initial icing, do not reice) is likely to be inadequate for warm oranges (b) in applying rule 249 (initial icing, one reicing) the cars should be reiced earlier than is customary.

7. Loss of fruit weight in transit was intermediate for controlled-ventilation, the least being for ice refrigeration.

8. Decay seemed more closely correlated with the average temperature attained than with the shipping service used.

9. Aging had somewhat the same temperature relation as decay.

10. The general appearance of the test fruit at destination was usually not greatly different between the three services.

11. Most of the commercial loads in the test cars sold at ceiling prices. When they did not the controlled-ventilation cars, with one slight exception, outsold those of the other two services.

12. The information regarding controlled vent handling indicated: (a) that too much conservatism was exercised by the observers at passing points in keeping vents closed, (b) that no vents should have been closed between loading point and Sparks, Nev. or Waynoka, Okla., and (c) that ~~in~~ in January probably no vents need have been closed before Ogden.

13. Some tentative recommendations were made which will be reconsidered later in this report.

14. During the December 1944 tests a rule of 20°F. minimum temperature for closing of the controlled vents was kept in mind. Then if a temperature forecast indicated that 20°F. or below would be encountered before the next passing point the control vents would be closed, or allowed to remain closed, in about the same manner as in handling standard vents under the closing rule of 32°F. The weather of December 1944 being extremely cold the controlled-vent cars seldom received much more ventilation than the standard-vent cars. However, during that series of tests and in later ones occasional mistakes were made which allowed the control vents to remain open through some near zero or even sub-zero weather. In no case, however, was there any freezing damage which could be attributed to the handling of test cars along the western portion of the trip.

It is with pleasure that we again acknowledge the efficient cooperation of the Managers of the Exchange District and Association packing houses, the Southern Pacific and Union Pacific railroads, and the Pacific Fruit Express Company.

METHODS

Each test shipment again consisted of two or more cars loaded and shipped from the same packing house on the same day. The ideal, not always attained, was three cars, thus allowing the simultaneous comparison of the three services, (a) standard ventilation, (b) controlled ventilation, and (c) ice refrigeration. The loads were of 561 boxes, with one channel in the deck layer.

The handling of the cars with respect to loading and en route was the same as previously described. However, only one class of test boxes carried comparable fruit, class C, none of which contained Ryan recording thermometers. The Ryans were in class B boxes which were not weighed. No/test boxes were used; they were substituted for by the weighing of the class C boxes. Class A.

Some comments were made in the previous report regarding the difficulty of securing test loads for one reason or another. It may be added here that the greatest difficulty met in the present tests came out of the very serious car shortage. The tests were finally discontinued for this reason.

The observers at passing points adopted a much more liberal policy this year than last in keeping controlled vents open. A number of difficulties previously met with in handling the cars en route did not appear during this series of tests. No cars of a test were reversed, and there was only one relatively brief separation of any car of a test, and only one case of a controlled vent being closed unauthorized. (This was only for a 3-hour period.)

RESULTS

Handling of the Vents on the Test Cars

The handling of the controlled vents was more effective in November-December 1945 than in the previous tests, especially those of December 1944. This increased effectiveness was due partly to the more favorable outside temperatures along the shipping route, but probably largely to the added experience of the observers at passing points.

After studying the results of all three series of tests during the 1944-45 Washington Navel orange season, it became rather clear that a car of warm oranges could withstand, without freezing, much more ventilation during sub-freezing weather than had previously been supposed. It was this situation which helped the passing point observers to secure very close to the maximum ventilation for the controlled-vent test cars during November and December of 1945. No 20°F. or even 15°F. closing rule was used strictly as a guide. The highest minimum outside temperature encountered by any controlled-vent car with vents open was 20°F. (see test 32). The minimum of test 31 was 10°F. The minimum of the six other tests ranged from -4 to 7°F. In test 33 the controlled-vent car had vents open through two minima of 4°F. before Ogden and of -3°F. between Ogden and Laramie, without apparent injury.

Between Central California and Ogden the coldest section has proved to be at and near Carlin. This is not only a cold spot, but the trains carrying the test cars usually pass through during the night when the minimum daily temperatures prevail. During generally cold weather across Nevada the Carlin section could offer a special difficulty in billing cars, "Vents open to Ogden". Fortunately the time through which this exposure occurs is normally relatively short. (See Figs. 6, 7, and 8).

The record of handling the vents of the CV and SV test cars and a comparison with the theoretical possibilities are shown in table 1. Regarding theoretical handling of the standard vents, column 6 of table 1 gives the percentage of time the vents were open when outside temperature was above 32°F. Correspondingly, columns 9 and 12 show the percentage of time the controlled vents were open when the outside temperatures were above 20°F. and 15°F. respectively. If the values in columns 9 and 12 are larger than 100 it means, of course, that the vents were open for varying periods when the outside temperatures were below 20°F. or 15°F., respectively. In other words, in such cases the controlled-vent cars received more ventilation than they should have if the vents had been handled strictly under a 20°F. or a 15°F. minimum closing rule.

Some further notes are given below on the handling of the cars in individual tests.

Test 31, NY. This was the first of the December 1945 series. Loaded Nov. 29, at Sunland. Out of Roseville 5:20 p.m. 12/1; Sparks 6:40 a.m. 12/2; Carlin 11:30 p.m. 12/2; Ogden 4:10 p.m. 12/3; Laramie 7:25 p.m. 12/4.

The lowest outside temperature encountered before reaching Ogden was 15°F. for a short time near Carlin (see Fig. 2). The vents of the controlled-ventilation (CV)[1/] car were open continuously to Ogden, but were closed between Ogden and Laramie. The vents of the standard ventilation (SV)[1/] car were closed for 12 hours over the Sierras and till about two hours before Sparks. There vents were again closed for 18 hours through the Carlin section, and closed out of Ogden. The refrigerated test car, rule 239, was reiced at Sparks, 4700 pounds of ice. The bunkers were 3/4-full at Laramie.

Test 32, NY. Loaded Nov. 30 , Sunland. Out of Roseville 12:45 p.m. 12/2; Sparks 1:30 a.m. 12/3; Carlin 4:30 a.m. 12/4; Ogden 7:45 p.m. 12/4; Laramie 10:00 p.m. 12/5.

The lowest outside temperatures encountered before Ogden were 28°F. just east of Sparks and 22° at Carlin (Fig. 3). The vents of the CV car were closed unauthorized for 3 hours before Sparks, but after Sparks they were open continuously to Ogden; also open out of Ogden but were closed before Laramie. The vents of the SV car were closed from 3 hours west of Sparks to Laramie excepting two periods; one of 4 hours, the other of 6 hours.

Test 33, NY. Loaded Dec. 3, Success. Out of Roseville 9:30 a.m. 12/5; Sparks 12:10 a.m. 12/6; Carlin 12:45 a.m. 12/7; Ogden 3:30 a.m. 12/8; Laramie 12:25 p.m. 12/8.

Lowest outside temperatures were two minima of 25°F. 8 hours east of Sparks and 8 hours west of Ogden, then a third minimum of -3°F. near Laramie (Fig. 4). The CV vents were open continuously from loading point to Laramie. No freezing was reported, although the lowest passing-point temperatures were dangerously low (table 2). Also the bottom quarter temperature as recorded by Ryan thermometers was 29°F. for 18 hours after Laramie, than it rose to 30°F. and remained constant to New York. No SV car in this test; the companion car was refrigerated, rule 249. Reiced at Sparks, 2400 pounds of ice. At Laramie the bunkers were still 5/8-full.

Test 34, NY. Loaded Dec. 4, Magnolia. Out of Roseville 4:35 a.m. 12/6; Sparks 10:30 p.m. 12/6; Carlin 9:00 p.m. 12/7; Ogden 10:00 a.m. 12/8; Laramie 2:15 p.m. 12/9.

Lowest outside temperature encountered before Ogden was 17°F. at Carlin, but between Ogden and Laramie the temperature dropped to 14° below zero (Fig. 5). The CV vents were open continuously from loading point to Ogden and also out of Ogden, but were closed on order at Green River. Fruit temperatures were rather low at Laramie but no freezing was reported. The SV vents were closed during three periods. totalling 39 hours, west of Ogden, and closed from Ogden to Laramie. The refrigerated car, rule 249, was reiced at Sparks with 3400 pounds of ice, and the bunkers were 5/8-full at Laramie.

1/ CV - controlled ventilation: SV - standard ventilation, and are so used throughout this report.

Test 35, NY. Loaded Dec. 5, Strathmore. Out of Roseville 4:30 a.m. 12/8; Sparks 10:30 p.m. 12/8; Carlin 11:30 p.m. 12/9; Ogden 2:00 p.m. 12/10; Laramie 3:00 p.m. 12/11.

Lowest temperatures encountered before Ogden were 17°F. near Sparks and 1°F. at Carlin (Fig. 6). The CV vents were open continuously from loading point to Ogden in spite of the almost zero temperature in the Carlin section. No freezing was reported. The vents were closed out of Ogden. The SV vents were closed for three periods totalling 43 hours, west of Ogden.

Test 36, Chicago. Loaded Dec.,6, Porterville. Due to failure of test 35 to move out of Strathmore on Dec. 5, both tests went out in the same train from Roseville, 4:35 a.m. 12/6. The CV vents of both tests were handled the same, but the SV vents of test 36 were closed for nearly 10 hours longer than those of the SV car of test 35. The refrigerated car, rule 249, was reiced at Sparks, 2800 pounds of ice. Bunkers were 3/4-full at Laramie.

Test 37, NY. Loaded Dec. 6, Sunflower. Out of Roseville on same train with tests 35 and 36.

The CV vents were open from loading point to Carlin where they were closed on order; not opened afterwards. Some freezing of fruit in the CV car was reported from New York, but this probably occurred during a period of 22 hours exposure to sub-zero weather east of Chicago. The refrigerated car, rule 249, was reiced at Sparks with 2600 pounds of ice. The bunkers were 3/4-full at Laramie.

Test 38, NY. Loaded Dec. 8, Grand View. Out of Roseville 7:30 a.m. 12/10; Sparks 10:30 p.m. 12/10; Carlin 8:50 p.m. 12/11; Ogden 11:00 a.m. 12/12; Laramie 6:00 p.m. 12/13.

Lowest temperatures encountered before Ogden were 21°F. near Sparks and +7°F. near Carlin (Fig. 9). Between Ogden and Laramie the minimum was -7°F. The CV vents were continuously open from loading point to Ogden and closed thereafter. The SV vents were closed 43 hours of the same period. The refrigerated car, rule 249, was reiced at Sparks with 3000 pounds of ice. The bunkers were 5/8-full at Laramie.

Records and Observations at Passing-Points.

1. Controlled and standard ventilation.

The passing-point fruit temperatures, as indicated by electric resistance thermometers in the fruit at certain critical positions in the load and read from the top of the cars at the hatches, again were of valuable aid in handling the vents of CV cars. This was especially true at Ogden where, with one exception, all CV cars arrived with vents open from Sparks. The passing-point fruit temperatures here indicated rather adequate cooling in the CV cars and, taking into consideration the low temperatures forecast for the route east of Ogden, the observer closed the CV vents, with the exception of two cars which seemed to need further cooling, and were therefore sent out with vents open; one open to Green River, the other to Laramie. The bottom and top bunker fruit temperatures

at loading and passing points are presented in table 2. Complete temperature records for passing points will be found on the large supplementary sheet at the end of the report.

The relative cooling of the standard-and controlled-vent cars west of Laramie as revealed by the average passing-point fruit temperature is shown in figure 1. The corresponding pairs of CV and SV cars can be followed by their test numbers. Graphs for the CV cars of tests 33 and 37 are also in figure 1, although their companion cars were refrigerated only.

2. Ice-refrigerated cars.

The refrigerated test cars of this series received somewhat better icing service than those in previous tests. Cars moving under rule 249 (initial icing, reice once in transit) were reiced at Sparks. This was requested because formerly the reicing had been delayed to West Laramie or eastward and was found to be too far. Sparks proved to be a little nearer than necessary, probably on account of the somewhat cooler loading temperatures of the fruit than in the previous tests. Carlin might have been a more preferable station for reicing but the icing plant there was not operating, and Ogden seemed too long a delay. In any case it should be kept in mind that for best results reicing will not necessarily be done at a certain point. It seems more reasonable to assume that the proper reicing point will vary with the year, season, or other factors. One refrigerated test car moved under rule 239 (preice, replenish, and reice once in transit) and it also was reiced at Sparks.

In test 33 both the CV and the refrigerated car carried two electric resistance thermometers in the fruit at the bottom and middle of stack 13 (i.e. at edge of doorway), 2nd row from the wall. The "bulbs" were read at passing points. The average of the two readings at each passing point were as follows:

	CV	Refr.
Loading point	58.5°F.	62.8°F.
Sparks	54.7	50.5
Ogden	46.6	48.8
Laramie	35.8	42.1

Heaters

By special request of the Exchange shippers no heaters were lighted before Laramie in either the CV or SV cars. At Laramie all CV cars were placed under standard ventilation rules, including Carrier's Volunteer Heater Service. From Laramie to Chicago, however, the outside temperatures apparently were not low enough to call for lighting the heaters except in two tests. In test 33 heaters were lighted at Laramie (-3°F.) and burned for 8 hours. In test 38 heaters were lighted also at Laramie (-5°F.) and burned 23 hours, during 11 of which the outside temperature was above 10°F. Heaters were lighted again 7 hours later and burned 26 hours, outside temperatures being between 1° and 5°F.

Records and Observations at Destination

1. Comparative temperatures of test loads.

The temperature records referred to here are from Ryan recording thermometers in the center of certain test boxes of fruit. There were usually two recordings of load temperatures per test car--at the quarterlength forward end centerline in the bottom and middle layers. The daily average temperatures of the middle quarterlength (MQ) and the bottom quarterlength (BQ) positions for each test car in transit are presented in table 3. The MQ temperatures are presented graphically in figures 2 to 9, inclusive. In these figures are also shown the outside temperatures encountered en route.

The MQ temperatures indicate that by the end of the 4th or 5th day after loading the CV cars had received what is generally considered adequate cooling. Cooling, unfortunately, made little or no progress till the 3rd day after loading, when the cars started moving down the eastern slope of the Sierras into Nevada. The total effects of controlled ventilation and ice refrigeration were approximately equivalent, but ice refrigeration showed some advantage since cooling, even under rule 249, can begin 24 hours sooner than that in the CV cars. A matter yet to be determined is whether or not fan cars under controlled ventilation could so effectively utilize the cool air of the two nights en route west of the Sierras as to overcome most of the slow rate of cooling.

2. Weight loss of test fruit in transit.

Table 4 presents the weight loss of test fruit in transit. The average differences in weight losses under the three services were of little if any significance. The figures show a slight advantage for refrigeration and controlled ventilation over standard ventilation. Before the ventilation tests were started, December 1944, it was feared that controlled ventilation, which implied a longer ventilation period than did standard ventilation, might cause a corresponding greater shrinkage of fruit. However, in the present series of tests, as well as in each of the three former series, the average loss of weight in the CV cars was slightly less than in the SV cars in spite of the longer ventilation of the former. The explanation no doubt lies in the effects of reduced temperature and higher relative humidity of the air entering the CV cars after the standard vents were closed; in addition, after the lowering of fruit temperatures, the consequent decrease of evaporation rate also became a contributory factor in checking loss of weight.

3. Condition of test fruit and notes on the commercial loads.

Table 5 presents a summary of the principal inspection data obtained on test lots at New York and Chicago, including those on decay, pitting, and aging, found on arrival and after a 10-day holding period.

The general comparative condition of the commercial fruit on arrival is given in the comments by inspectors of the U. S. Department of Agriculture and the California Fruit Growers Exchange. These comments are briefed and

offered below as supplementary to the data in table 5. It must be kept in mind that these comments are on different lots which with only one exception, were not comparable. Hence the observations noted are of general interest only but without particular bearing on the experimental procedures under test.

Test 31, NY. Naked pack. USDA: Fruit showed no sign of freezing in any of the cars. In some cases that from the refrigerated car seemed slightly freshest in appearance. No difference could be noted in other cars except that fruit from the SV car was least fresh. CFGE: Fruit firm and slightly wilted at stem ends. Practically sound. Naked packs and some discolored bruised spots under cover and at sides of the boxes. Buttons black.

Test 32, NY. Naked pack. USDA: All oranges bright; no difference in freshness, no difference in condition noted. CFGE: Fruits firm and mostly slightly wilted at stem-end; practically sound with an occasional pitted orange. Buttons black.

Test 33, NY. Wrapped pack. USDA: Fruit excellent in quality, better in this respect than that in earlier tests. No aging found. No difference between the two cars. CFGE: The two shipments were similar in appearance. Fruit firm and fairly fresh appearing. Practically sound, with a few pitted oranges in the test boxes.

Test 34, NY. Wrapped pack. USDA: Examiners thought the refrigerated fruit slightly fresher than that in either of the ventilated cars, but difference so slight as to be of no commercial significance. No frozen fruits. CFGE: Fruit firm to some slightly soft. Most fruits slightly wilted at stem end to considerable fairly fresh appearing. Buttons mostly grey to some green.

Test 35, NY. Wrapped pack. USDA: No comparison was made of the commercial portions of the two cars. No frozen fruits in test boxes. CFGE: Fruits in the two shipments practically the same in appearance. Commercial loads; mostly firm to fairly firm and fairly fresh appearing. Practically sound. Buttons mostly black.

Test 36, Chi. Wrapped pack. USDA: No significant difference in condition of the fruit of the three cars; firm to fairly firm, with buttons green to yellow green. Mostly good to fairly good quality; fairly bright to slightly dull in appearance. CFGE: CV car: Fruit fairly firm to firm; buttons intact. SV car: Fruit generally pliable to occasional soft; most buttons intact. Refrigerated car: Fruit sound; fairly firm to pliable. Some buttons missing.

Test 37, NY. Naked pack. USDA: In the CV car frozen fruits were found along the bottom edge at the doorways and extending to quarter-length positions in each end. At doorways the bottom-layer wall boxes were frozen about 1/4 of the way up from the floor. These affected floor boxes were marked and set aside but later were returned to the piles and sold with the remainder of the fruit. Undoubtedly there was a scattering of frozen fruit against the floor in other boxes near the wall of the car, but the freezing was of no commercial importance. Ryan records indicate that the freezing occurred chiefly during the last three days of

the trip. On arrival the fruit from the two cars was equal in appearance. CFGE: In the CV car the fruit was firm and practically sound; buttons mostly grey. Fifty-one boxes were frozen en route. These came out of the lower layer. The damage was confined to the wall-row boxes on both sides of the car but it did not show all the way to the bunker walls. Boxes in the first three to four stacks in each end of the car were free from frost. In the refrigerated car the fruit was firm and fairly fresh appearing. Fruit sound. Buttons mostly greyish green.

Test 38, NY. Wrapped pack: USDA: No consistent difference in appearance of the fruit from the two cars, but the SV car contained considerably more decay in the test boxes. CFGE: Fruit in the three shipments was practically similar in appearance. Firm and fairly fresh appearing. Practically sound. Buttons mostly grey.

From table 5 it may be seen that the percentage of decay on arrival was of little importance. In no case was there more than 1 percent, except in the SV car of test 38. On the whole, the amount of decay in the cars was not sufficient to bring out strongly the potential relative effects of any of the three services.

The average amounts of pitting of the test fruit on arrival showed very little difference between the three services. When it is considered that the highest average percentage of fruit showing some degree of pitting under any service was only 1.59, the unimportance of pitting as an index in these tests is clear. After holding fruit for ten days pitting showed an increase--about three times that at arrival-- but still was in no significant relation to the service.

Aging appearing in the test fruit at arrival was usually too slight to mention; the largest amount recorded was 0.17 percent. After holding ten days the amount reported varied from zero to 10.75 percent, but its occurrence was too erratic in relation to service to be of much significance.

4. Sales of test shipments.

Table 6 presents the account sales from New York and Chicago for the commercial loads of all test shipments.

As a whole, there appears very little difference in the selling prices of the fruit from the three transportation services which cannot be attributed to the distribution of sizes and brands in the loads.

SUMMARY

Shipping tests with California winter (Washington Navel) oranges begun in the season of 1944-45 were renewed for the second season, 1945-46, in November and December 1945. All shipments were made from Tulare County over the SP-UP route. There were eight tests, consisting of 8 cars under controlled ventilation, 5 under standard ventilation, and 6 under ice refrigeration.

The entire procedure of the tests was practically identical with that previously employed, and described in U. S. Department of Agriculture H. T. & S. Office Report No. 163.

The vents of the controlled ventilation cars were handled more effectively than in previous tests and this, associated with rather favorable weather conditions en route, produced some results seemingly quite favorable to this type of service. In 6 of the 8 tests controlled vents were continuously open to Ogden and in two of the six the vents were open out of Ogden--one to Green River, the other on to Laramie. Of the two vents closed before Ogden, one was closed unauthorized over the Sierras and the other by order at Carlin. The amount of cooling by ventilation obtained east of the crest of the Sierras and across Nevada was equivalent or superior to that by ice refrigeration. West of the Sierras the ice-refrigerated cars under rule 249 showed some advantage over controlled ventilation, due no doubt to the generally warmer outside temperatures and to the fact that the refrigerated cars were iced about 24 hours before the test cars encountered weather favorable for ventilation.

The ice-refrigerated cars, mostly under rule 240 (initial icing, one reicing) proved more satisfactory than in previous tests in which rule 240 (initially iced, do not reice) was used. Reicing was at Sparks which, under the circumstances, was perhaps somewhat sooner than necessary.

Loss of weight of fruit in transit was practically the same in the controlled-ventilation and ice-refrigerated cars, being less in both than in the standard-ventilation car.

Decay of fruit in transit was always less than one percent, with a single exception, and could not be used as a factor in comparing merits of the three services.

Pitting and aging occurred either in too small amounts or too erratically to be used for judging relative merits of the services.

Account sales. Most of the differences in sale prices of the commercial loads were small with respect to services and might be explained largely as due to the distribution of grades and sizes.

TENTATIVE RECOMMENDATIONS

1. Modification of ventilation rules based upon the results of shipping tests during the Washington Navel orange seasons of 1944-45 and 1945-46:

(a) To permit ventilated cars to be billed from loading point to some designated point en route with waybill reading, "Vents open to _____, standard ventilation thereafter."

From Central California via the SP-UP the most desirable point en route seems to be Ogden. It is still quite clear that no vents should be closed before Sparks. Vents billed open to Laramie would require supervision beyond any which could be expected, because of the potentially very cold Green River section. And it is somewhat doubtful that vents can be left open to Ogden without some sort of supervision.

(b) To permit a combination billing, "Vents open above _____ (designate temperature) to _____ (designate point); standard ventilation thereafter."

At present it would seem both effective and safe to bill warm orange loads over the SP-UP route, "Vents open above 70°F. to Ogden; standard ventilation thereafter." With such billing the vents would only rarely need to be closed more than during night runs through the Carlin section.

The designation of a particular temperature at which vents should be closed should be dependent on the temperature of the fruit when loaded and the prevailing weather conditions in California. If the fruit is at 60° to 80° and the weather is warm in California the total amount of heat to be removed before the temperature of the load is so reduced that it is in danger of freezing is much greater than if the fruit is at 40° or 50° and the weather is cool. In other words the potential heat load to be contended with should be considered in selecting the temperature at which vents are to be closed or the place from which the vents shall be manipulated according to temperatures outside the car rather than inside.

(c) The present tests furnished no direct evidence for recommending changes in standard ventilation rules east of Laramie.

2. Heater Service. The recommendation stands that heaters should not be lighted in ventilated cars before Laramie. However, heater service should be maintained east of Laramie, especially on the assumption that a modified ventilation practice will have given adequate cooling of the load before Laramie.

3. Additional ventilation studies that are desirable with California winter oranges:

(a) Tests should be made over the Santa Fe out of Central California; also probably more from Southern California.

One of the purposes of such tests would be to check the safety of Belen or some other point en route as a designated point to which vents may be billed open.

(b) Tests should be made with fan cars under controlled ventilation out of Central California to determine to what extent fan cars can overcome the disadvantages of ventilation through the warmer temperatures west of the Sierras.

Table 1. Record of Vents of Controlled and Standard Ventilation Test Cars.

Test		Total Hrs in transit to Ogden	Total Hrs vents open Ogden	No. Hrs Temp above 32°F.	Theoretical 1/ Max. time vents should have been open to Ogden		No. Hrs Temp below 20°F.	Theoretical 1/ Max. time vents should have been open to Ogden		No. Hrs Temp below 15°F.	Theoretical 1/ Max. time vents should have been open to Ogden	
1		2	3	4	5	6	7	8	9	10	11	12
		Hrs	Hrs	Hrs	Hrs	%	Hrs	Hrs	%	Hrs	Hrs	%
31	CV	97	87	28	69	--	8	89	109	0	97	100
	SV	97	51	28	--	74	-	--	--	-	--	---
32	CV	103	100	18	85	--	0	103	97	0	103	97
	SV	103	65	18	--	76	-	--	--	-	--	---
33	CV	101	101	18	83	--	-	101	100	0	101	100
	Companion car Refrig.				--							
34	CV	91	91	36	55	--	12	79	115	0	91	100
	SV	91	52	36	--	95	-	--	---	-	--	---
35	CV	117	117	42	75	--	21	96	122	11	105	111
	SV	117	74	42	--	99	-	--	---	-	--	---
36	CV	99	99	42	57	--	27	72	137	13	86	115
	SV	99	48	42	--	84	-	--	---	-	--	---
37	CV	99	81	58	41	--	27	72	112	13	86	94
	Companion car Refrig.											
38	CV	91	91	36	55	--	15	76	120	12	79	115
	SV	91	48	36	--	87	-	--	---	--	--	---

1/ On basis CV vents open to 20° and 15°F.; SV vents open to 32°F.

NB. Column 2 - Loading point to Ogden
" 3 - Observed number of hours vents were actually open.
" 4 - Observed from the recorded Temps of the outside air through which the given test passed.
" 5 - Column 2 minus column 4.
" 6 - Column 3 divided by column 5.
" 4 to 6 for SV on basis of 32°F.
" 7 - after same manner as column 4.
" 8 - Column 2 minus column 7.
" 9 - Column 3 divided by column 8.
" 7 to 9 for CV on basis of 20°F. closing rules
" 10 to 12 " " " " " 15°F. " "
" 10 - after same manner as column 4.
" 11 - Column 2 minus column 10.
" 12 - Column 3 divided by column 11.

Table 2. Fruit Temperatures at Bunkers of Controlled and Standard Ventilated Cars at Passing Points. Tulare County.

CV - Controlled ventilation
SV - Standard ventilation

BB - Bottom bunker
TB - Top bunker
B13 - Bottom, 13th tier (at doorway)
T13 - Top, 13th tier

Test		Loading Point	Sparks	Ogden	Laramie	Avg.
		°F	°F	°F	°F	°F
31 CV	BB	65.3 (56)[1]	39.8 (16)	29.3 (30)	29.6 (32)	41.0
	TB	68.4 72 hrs[2]	48.0 36 hrs	30.6 28 hrs	36.8	45.9
SV	BB	68.9	45.6	40.1	41.6	49.0
	TB	69.0	54.8	48.5	47.5	54.9
32 CV	BB	67.2 (54)	47.1 (32)	35.5 (44)	36.8 (21)	46.6
	TB	69.5 59 hrs	50.6 44 hrs	39.5 26 hrs	42.7	50.6
SV	BB	59.8	47.4	45.8	48.1	50.3
	TB	66.7	59.2	55.2	54.4	58.9
33 CV	BB	50.5 (67)	46.5 (35)	37.2 (28)	28.8 (-3)	40.7
	TB	54.8 54 hrs	46.8 47 hrs	38.3 28 hrs	32.3	40.5
	B13	57.5	49.1	38.0	28.0	43.1
	T13	59.4	60.2	54.3	43.7	54.4
Refr	B13	62.0	44.5	40.5	38.7	46.4
	T13	63.7	56.5	47.2	45.5	53.2
34 CV	BB	67.5 (60)	54.9 (48)	38.2 (31)	31.0 (14)	47.9
	TB	64.4 49 hrs	60.4 42 hrs	41.6 28 hrs	37.0	50.8
SV	BB	65.5	50.9	50.0	49.8	54.0
	TB	71.2	56.7	57.4	56.1	60.3
35 CV	BB	66.3 (48)	44.1 (25)	29.3 (26)	29.4 (24)	42.3
	TB	75.5 74 hrs	56.0 42 hrs	32.0 26 hrs	34.8	49.6
SV	BB	71.5	49.6	45.7	46.2	53.2
	TB	79.4	60.6	61.9	56.9	64.7
36 CV	BB	75.1 (55)	49.2 (25)	29.6 (26)	30.7 (24)	46.1
	TB	75.7 56 hrs	56.0 42 hrs	35.5 25 hrs	36.2	50.8
SV	BB	79.2	48.8	46.9	45.3	55.0
	TB	68.8	54.0	54.3	51.8	57.2

1/ Figures in parenthesis are outside temperatures.
2/ Actual number of hours in transit between passing points.

(Table cont'd next page)

Table 2. (Cont'd)

Test		Loading Point	Sparks	Ogden	Laramie	Avg.
		°F	°F	°F	°F	°F
37 CV	BB	64.1 (55)	42.4 (25)	30.1 (26)	34.0 (24)	42.6
	TB	68.8 56 hrs	39.8 42 hrs	35.5 25 hrs	37.8	45.5
SV	No SV car; Companion car refrigerated.					
38 CV	BB	68.0 (53)	50.5 (30)	31.2 (21)	31.5 (-5)	45.3
	TB	69.5 47 hrs	56.0 44 hrs	29.5 32 hrs	31.8	46.7
SV	BB	66.3	47.8	50.8	43.7	52.1
	TB	66.7	49.7	57.4	51.5	56.3

Table 3. Daily Average MQ and BQ Temperatures of Test Cars in Transit, 1945-46. (From Ryan recording thermometer tapes.)

Test	Billing	Position	Days 1 °F	2 °F	3 °F	4 °F	5 °F	6 °F	7 °F	8 °F	9 °F	10 °F	11 °F	12 °F	13 °F	14 °F	Avg. °F
31 NY	CV	MQ	68.8	63.0	56.6	44.5	35.5	36.0	35.0	35.0	34.5	34.0	35.0	--	35.0		42.8
		BQ	63.3	57.1	4[illegible].7	33.4	29.4	30.0	30.0	32.0	34.0	33.0	33.5	35.0	35.0		38.8
	SV	MQ	68.5	64.9	58.7	54.7	51.3	50.0	47.0	45.5	45.0	45.0	45.0	45.0	45.0		51.2
		BQ	67.0	56.8	48.6	46.2	43.0	42.0	41.5	40.0	40.0	40.0	42.0	40.5	40.0		45.2
	Refr	MQ	71.6	64.7	54.4	49.6	46.2	42.9	40.5	39.5	38.5	38.0	37.0	38.0	38.5		46.1
		BQ	61.1	44.9	39.7	40.0	40.0	39.0	39.0	38.0	38.0	38.0	38.0	37.0	36.0		40.7
32 NY	CV	MQ	69.0	58.2	59.2	53.4	46.6	45.0	43.5	43.0	41.5	40.0	40.0	40.0	39.5		48.1
		BQ	No readings taken.														
	SV	MQ	69.0	64.1	57.8	54.2	52.7	52.0	52.0	52.0	47.0	45.0	44.0	43.0	42.0		51.9
		BQ	No readings taken.														
33 NY	CV	MQ	56.7	59.0	59.0	56.5	53.0	48.1	44.5	43.5	42.5	41.5	41.0	41.0	40.0	40.0	47.6
		BQ	54.0	53.5	52.5	45.1	40.5	33.2	29.0	29.5	30.0	30.0	30.0	30.0	30.0	30.0	36.9
	Refr	MQ	64.2	57.2	55.6	52.3	49.5	47.2	44.5	43.5	42.0	41.0	40.0	40.0	40.0	40.0	46.2
		BQ	59.6	54.7	48.0	43.7	41.1	39.2	37.5	37.0	36.0	36.0	35.5	35.0	35.0	35.0	40.9
34 NY	CV	MQ	73.0	71.7	67.1	61.0	53.7	47.5	46.0	44.5	43.5	42.0	41.0	40.5	40.0	39.5	50.6
		BQ	69.5	61.5	55.5	47.5	37.7	31.6	30.0	30.0	29.0	29.0	29.0	29.0	29.0	29.0	38.4
	SV	MQ	72.0	70.3	67.7	64.7	62.0	61.0	60.0	59.0	58.5	57.5	57.0	57.0	56.5	56.0	61.4
		BQ	69.7	65.6	57.3	51.2	49.0	49.0	48.0	46.7	44.5	43.0	42.0	42.0	41.0	40.5	49.1
	Refr	MQ	71.7	69.7	64.5	59.7	55.1	52.3	49.5	47.8	45.0	44.0	43.0	42.5	41.0	41.0	51.9
		BQ	72.3	63.9	51.7	45.5	42.1	39.0	38.0	37.0	36.0	36.0	36.0	36.0	36.0	35.0	43.2

Table 3. (Cont'd)

Test	Billing	Position	Days 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Avg.
			°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
35 NY	CV	MQ	74.0	70.7	65.7	61.4	54.2	46.2	43.7	43.0	42.5	42.0	40.5	39.5	38.0	37.0	49.9
		BQ	Failed to record.														
	SV	MQ	71.0	64.5	64.6	62.1	58.6	55.2	54.4	53.0	52.5	51.0	49.5	48.0	46.5	46.0	55.5
		BQ	73.0	62.2	57.2	53.6	49.6	44.3	44.4	43.5	43.0	43.0	41.5	39.5	38.0	37.0	47.8
36 Chi	CV	MQ	65.1	67.3	63.9	55.3	43.9	40.0	40.0	40.0	40.0	40.0	40.0				48.7
		BQ	78.0	65.7	63.0	56.7	44.9	33.0	31.0	32.0	32.5	33.0	34.0				48.5
	SV	MQ	67.0	66.0	61.7	57.4	54.7	54.0	53.0	52.0	51.5	51.0	51.0				56.3
		BQ	64.6	54.5	47.7	42.2	41.0	41.0	41.0	41.0	41.0	40.0	40.0				45.0
	Refr	MQ	68.0	64.1	57.0	51.2	47.1	44.0	41.5	39.5	38.0	38.0	37.0				47.8
		BQ	64.8	55.3	44.2	39.1	36.5	35.0	34.0	33.5	33.0	33.0	33.0				40.1
37 NY	CV	MQ	66.7	63.1	55.9	46.4	40.5	39.5	39.0	38.0	37.5	38.5	36.0	35.5	35.0		43.8
		BQ	59.6	45.7	43.7	30.8	26.2	27.7	28.0	28.5	29.0	28.0	26.0	25.0	25.0		32.9
	Refr	MQ	65.4	59.3	51.0	45.2	41.3	38.8	37.0	36.0	36.0	36.0	36.0	36.0	36.0		42.6
		BQ	59.1	48.7	39.6	37.4	36.0	35.2	35.0	35.0	35.0	35.0	35.0	34.0	34.0		38.1
38 NY	CV	MQ	68.0	67.3	67.6	63.0	55.9	52.9	49.5	49.0	48.0	47.0	47.0	46.0			54.9
		BQ	66.6	60.2	54.2	43.8	33.2	32.0	32.0	32.5	32.5	32.0	32.0	31.0			40.2
	SV	MQ	69.0	69.0	68.0	67.0	66.5	66.2	65.0	66.5	67.0	66.0	64.5	63.0			66.4
		BQ	68.2	63.0	57.2	53.7	52.5	50.5	49.0	49.0	47.5	45.0	44.0	43.0			51.9
	Refr	MQ	69.0	67.2	61.8	56.8	52.6	49.3	46.5	43.5	42.5	41.0	40.0	39.0			50.8
		BQ	61.3	51.1	39.3	34.1	31.2	29.4	28.0	28.0	27.0	27.0	26.5	26.0			34.1

Table 4. Weight Loss of Test Fruit in Transit. Tulare County. Nov-Dec. 1945.

Test	Car No. & Services	Pack	Days in Tr.	Weight Loss in Transit						Avg.
				Bottom Layer		Middle Layer		Top Layer		
				Box C		C		C		
				Lb	%	Lb	%	Lb	%	%
31	RD 34442 CV	N[1/]	13	1.1	1.39	1.6	2.06	1.2	1.49	1.64
NY	RD 34876 SV	"	13	1.6	2.02	1.6	1.99	1.4	1.78	1.93
	RD 15069 Refr	"	13	1.1	1.37	1.4	1.74	1.6	2.00	1.70
32	PFE 46108 CV	N	12	1.4	1.78	1.4	1.74	1.8	2.26	1.93
NY	" 45132 SV	"	12	1.8	2.23	2.1	2.63	2.3	2.89	2.58
33	PFE 41215 CV	W[1/]	13	1.1	1.33	1.3	1.57	1.1	1.33	1.41
NY	URTX 35014 SV	"	13	1.1	1.34	1.1	1.35	1.1	1.31	1.33
34	PFE 74383 CV	W	13	1.2	1.45	1.7	2.11	1.8	2.15	1.90
NY	" 92775 SV	"	13	1.3	1.62	1.4	1.74	1.2	1.49	1.62
	RD 7950 Refr	"	13	1.1	1.34	1.6	1.95	2.7	3.33	2.20
35	PFE 98656 CV	W	13	1.3	1.57	(3.5)	(4.30)	1.2	1.43	1.50
NY	" 91066 SV	"	13	1.4	1.67	1.4	1.67	2.7	3.19	2.18
36	PFE 93890 CV	W	10	0.8	0.99	0.8	0.99	1.2	1.49	1.16
Chi	" 93982 SV	"	10	0.7	0.89	1.4	1.74	1.3	1.58	1.40
	" 98541 Refr	"	10	0.6	0.76	1.0	1.22	1.2	1.49	1.16
37	PFE 46219 CV	N	12	1.0	1.24	1.0	1.25	1.3	1.64	1.38
NY	" 96439 Refr	"	12	1.1	1.36	1.3	1.60	1.1	1.38	1.45
38	PFE 60003 CV	W	11	1.1	1.31	1.6	1.95	1.1	1.35	1.54
NY	" 64138 SV	"	11	1.1	1.35	1.2	1.47	1.1	1.32	1.38
	" 94333 Refr	"	11	1.0	1.19	1.2	1.46	1.2	1.47	1.37
								Controlled vent		1.56
								Standard vent		1.85
								Refrigeration		1.54

1/ N - Naked pack. W - Wrapped pack.

Table 5. Condition of Test Fruit on Arrival and after Holding 10 days at 67-68°F. and 40-45% Relative Humidity in New York and at 45°F. in Chicago.

Test	Car and Billing		Arrival			After Holding Ten Days			
			Decay	Pitting		Decay	Pitting		Aging
				Sl	Svr		Sl	Svr	
			%	%	%	%	%	%	%
31	RD	34442 CV	.17	.83	.83	.75	2.00	2.50	7.00
Naked	"	34376 SV	.33	.50	.17	.50	1.00	2.50	4.00
NY	"	15069 Refr	0	.83	0	.25	2.00	2.00	5.77
32	PFE	46108 CV	0	1.00	0	1.00	.75	3.25	10.75
Naked	"	45132 SV	.50	.67	0	2.75	.50	1.75	6.25
NY									
33	PFE	41215 CV	.67	0	0	5.00	0	0	0
Wrapped	URTX	35014 Refr	.50	.50	0	5.50	2.00	1.00	0
NY									
34	PFE	74383 CV	.50	.33	.17	1.75	.25	3.00	4.00
Wrapped	"	92775 SV	.83	.67	0	1.50	.25	2.50	3.00
NY	RD	7950 Refr	.50	.33	1.00	3.50	.25	2.25	2.50
35	PFE	98656 CV	.83	.17	0	3.00	0	2.20	4.83
Wrapped	"	91066 SV	.67	0	0	.83	.17	2.00	3.67
NY									
36	PFE	93890 CV	0	2.82	.82	.25	5.00	2.00	--
Wrapped	"	93982 SV	0	3.50	1.16	.50	5.25	3.00	--
Chi	"	98541 Refr	0	4.60	1.30	.50	4.25	1.75	--
37	PFE	46219 CV	.17	0	.17	3.50	.50	2.50	4.50
Naked	"	96439 Refr	0	0	0	.50	0	2.00	5.50
NY									
38	PFE	60003 CV	.50	0	0	4.00	.50	3.50	1.50
Wrapped	"	64132 SV	3.50	0	0	5.50	0	.50	1.50
NY	"	94333 Refr	.33	1.00	0	3.50	.50	5.50	1.00
Averages		CV	.36	.64	.25	2.28	1.13	2.39	4.65
		SV	.97	.89	.22	1.93	1.20	2.04	3.38
		Refr	.22	1.21	.38	2.13	1.50	2.42	2.68

Table 6 . Account Sales of Test Cars Sold in New York and Chicago.

Test		Brand	Size 80	100	126	150	176	200	220	252	288	Avg.
31 NY	CV	Dominant				7.60	7.60	6.35	6.35			6.90
		Good Cheer		7.25	7.25	6.85	6.50	6.10	4.70			5.96
	SV	Dominant				7.70	7.70	6.20	6.20	6.20		7.08
		Good Cheer		7.25	7.25	6.90	6.55	(5.90 5.85	(4.30 4.25	3.75		5.80
	Refr	Dominant				8.10	7.95	7.05	5.65			7.28
		Good Cheer		7.60	7.60	7.05	6.60	5.90	(4.45 4.40	3.60	3.60	5.74
32 NY	CV	Dominant			6.95	6.95	6.95	6.95	6.95			6.95
		Good Cheer		7.50	7.50	6.80	(6.30 6.25	5.60	(4.75 3.45			5.84
	SV	Dominant				6.60	6.60	6.60	6.60			6.60
		Good Cheer		7.75	7.75	6.80	6.40	5.90 5.85	4.90 4.85	3.60		5.97
33 NY	CV	Golden Trail		9.65	9.65	8.55	8.00	7.35	6.40	4.80		6.96
		Dawn-O-Gold		7.00	7.00	5.85	5.85					6.37
	Refr	Golden Trail		10.20	9.25	8.65	8.05	(7.40 7.35	6.15	4.50	3.50	7.04
		Dawn-O-Gold		8.05	8.05	7.80	7.50	6.40	5.30			6.78
34 NY	CV	Malta		8.00	8.00	7.55	7.15	6.60	5.95	4.85		6.77
		Manager		7.00	7.00	6.70	6.35	5.60	5.05			5.98
	SV	Malta		8.00	8.00	7.50	7.40	6.85	6.20	4.65		6.49
		Manager		6.80	6.80	6.80	6.20	5.60	5.05	4.00		5.81
	Refr	Malta		9.00	9.00	8.20	7.35	6.75	5.80	4.65		6.70
		Manager		6.60	6.60	6.60	6.25	5.65	4.95			5.91
35 NY	CV	Strathmore	7.55	7.55	7.55	7.15	7.05	6.80	5.80	4.70		6.73
		Annie Laurie		6.50	6.50	6.50	6.15	5.95	4.30	4.30	4.30	5.50
	SV	Strathmore		7.65	7.65	7.35	7.20	6.90	5.40			6.85
		Annie Laurie		6.90	6.90	6.90	6.45	5.70	4.50			5.64

Table 6 . (Cont'd)

Test	Brand	Size 80	100	126	150	176	200	220	252	288	Avg.
36 CV Chi.	Gold Hill		8.05	7.55	7.30	7.00	5.70	5.30	4.35		6.37
	Tam O'Shanter		4.75	4.75	4.75	4.75	4.75	4.75	4.75		4.75
SV	Gold Hill	8.05	8.05	7.45	7.25	7.00	5.65 5.60	5.20 5.15	4.20		6.20
	Tam O'Shanter		4.65	4.65	4.65	4.65	4.65	4.65	4.65		4.65
Refr	1000 Grand	8.05	8.05	7.50	7.30	7.05	5.50	5.30 5.25	4.20		5.97
	Tam O'Shanter		4.90	4.90	4.90	4.90	4.90	4.25	3.25		4.15
37 CV NY	Porter		7.05	7.05	7.05	6.85	6.45	5.00	4.40	3.90	5.90
	(*frozen)		4.75*	4.75*	4.75*	4.75*	6.40 4.75*	4.75*	4.75*	4.74*	
	Azalea		5.55	5.55	5.55	5.55	5.30				5.46
Refr	Porter		6.90	6.90	6.95	6.80	6.30	5.30 5.25	4.35	3.95	6.00
	Azalea				6.15	6.15	6.15				6.15
38 CV	Ultra		8.00	8.00	7.75	7.75	7.35	5.75	4.85		7.04
	Grand Pak		6.80	6.80	6.90	6.55	5.90	5.05	4.60		5.96
SV	Ultra		8.45	8.45	8.00	7.95	7.55	5.75	4.75	4.00	6.87
	Grand Pak		6.90	6.90	7.00	6.55	5.90	4.85	4.00		5.61
Refr	Ultra	[illegible]	8.50	7.70	7.75	7.60	7.25	5.85	4.95		6.97
	Grand Pak	6.75	6.75	6.75	6.80	6.60	5.85	5.10	4.30		5.91

FIG. 2

TEST 31 (1945)

MIDDLE QUARTERLENGTH TEMPERATURE

DEGREES F.

80
70
60
50
40
30
20
10
0

STD. VENT. (SFRD 34376)

REF. (SFRD 15069)

CONT. VENT. (SFRD 34442)

OUTSIDE AIR

LOADING POINT

SPARKS, NEV.

CARLIN, NEV.

OGDEN, UTAH.

LARAMIE, WYO

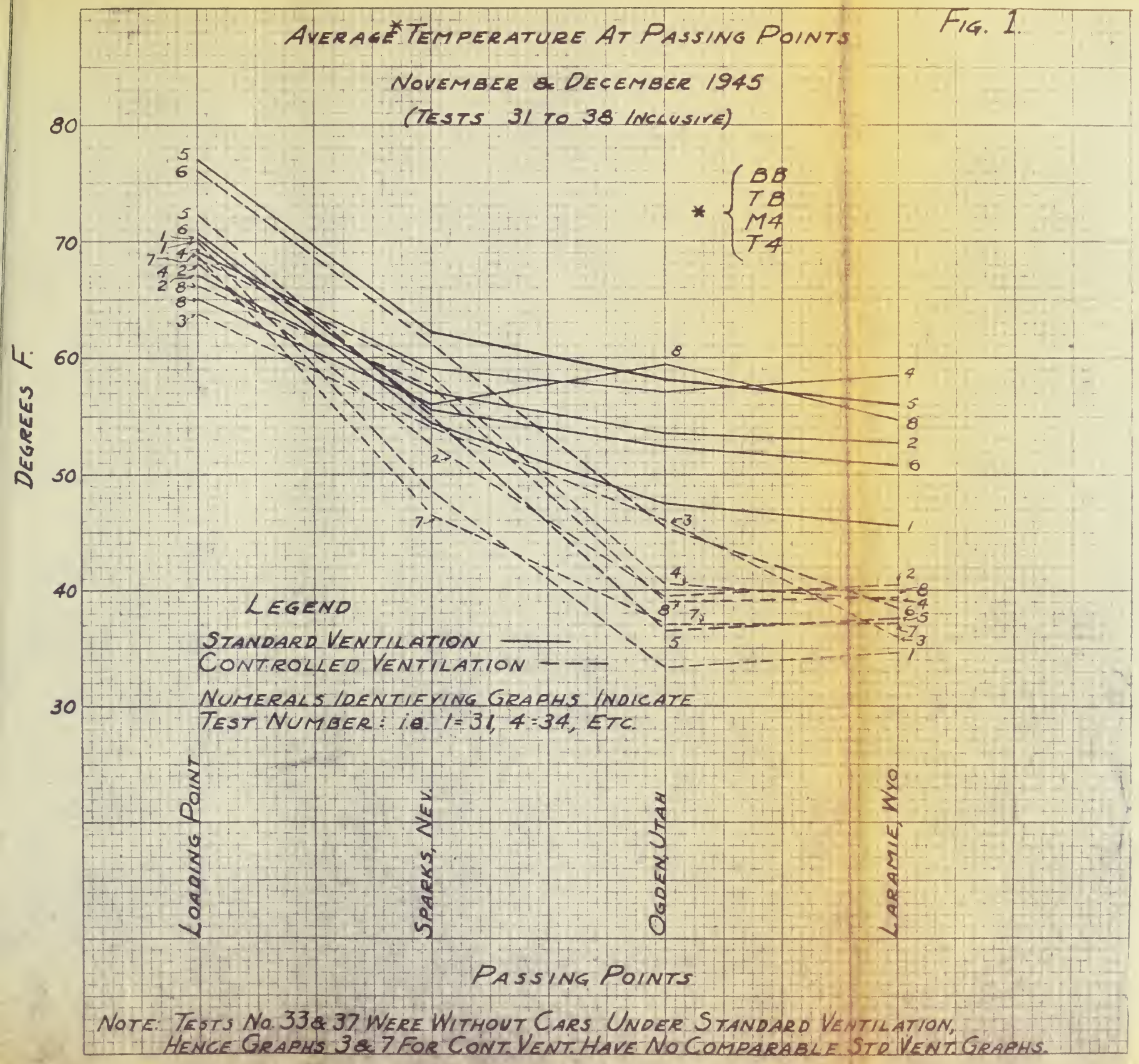
Nov. 29 30 DEC. 1 2 3 4 5 6 7 8 9 10 11

FIG. 1.

AVERAGE* TEMPERATURE AT PASSING POINTS

NOVEMBER & DECEMBER 1945

(TESTS 31 TO 38 INCLUSIVE)



NOTE: TESTS No. 33 & 37 WERE WITHOUT CARS UNDER STANDARD VENTILATION, HENCE GRAPHS 3 & 7 FOR CONT. VENT. HAVE NO COMPARABLE STD VENT. GRAPHS.

FIG. 3

TEST 32 (1945)

MIDDLE QUARTERLENGTH TEMPERATURE

DEGREES F.

80
70
60
50
40
30
20
10
0

STD. VENT. (PFE 45132)

CONT. VENT. (PFE 46108)

OUTSIDE AIR

LOADING POINT

SPARKS, NEV.

CARLIN, NEV.

OGDEN, UTAH.

LARAMIE, WYO.

Nov. 30 DEC. 1 2. 3 4 5 6 7 8 9 10 11 12

FIG 4

TEST 33 (1945)

MIDDLE QUARTERLENGTH TEMPERATURE

DEGREES F.

80
70
60
50
40
30
20
10
0

LOADING POINT
SPARKS, NEV.
CARLIN, NEV.
OGDEN, UTAH.
LARAMIE, WYO.

DEC 3 4 5 6 7 8 9 10 11 12 13 14 15 16

CONT. VENT. (PFE 41215)

REF. (URT 35014)

OUTSIDE AIR

FIG.

TEST 34 (1945)

MIDDLE QUARTERLENGTH TEMPERATURE

STD. VENT. (PFE 92775)

REF. (SFRD 7950)

CONT. VENT. (PFE 74383)

OUTSIDE AIR

DEGREES F.

80
70
60
50
40
30
20
10
0

LOADING POINT
SPARKS, NEV.
OGDEN, UTAH.
LARAMIE, WYO.

DEC 4 5 6 7 8 9 10 11 12 13 14 15 16 17

FIG. 6

TEST 35 (1945)

MIDDLE QUARTERLENGTH TEMPERATURE

STD. VENT. (PFE 91066)

CONT. VENT. (PFE 98656)

OUTSIDE AIR

DEGREES F.

80
70
60
50
40
30
20
10
0

LOADING POINT

SPARKS, NEV.

CARLIN, NEV.

OGDEN, UTAH.

LARAMIE, WYO

DEC 5 6 7 8 9 10 11 12 13 14 15 16 17 18

FIG. 7

TEST 36 (1945)

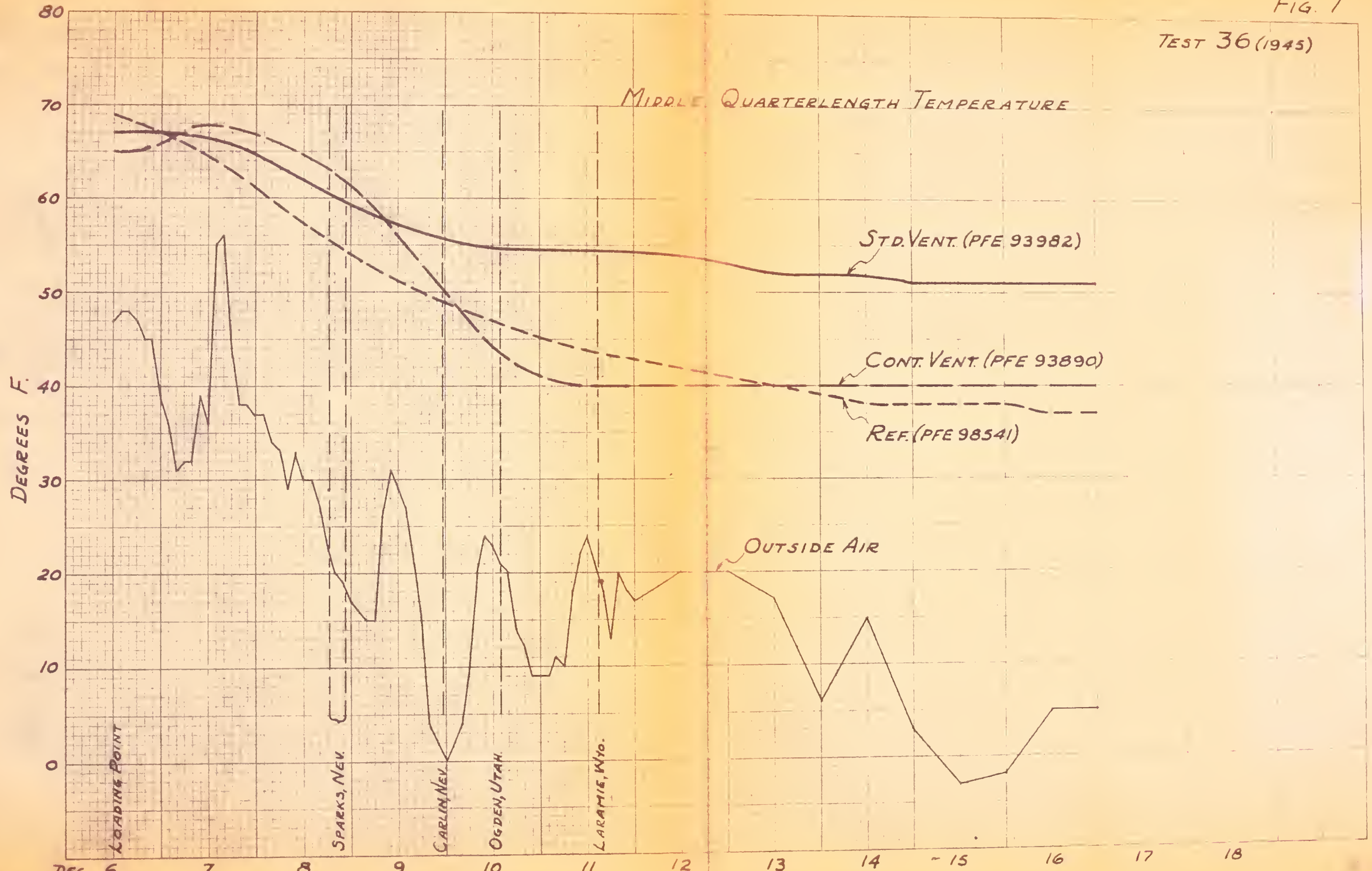


FIG. 8

TEST 37 - (1945)

MIDDLE QUARTERLENGTH TEMPERATURE

CONT. VENT. (PFE 46219)

REF. (PFE 96439)

OUTSIDE AIR

DEGREES F.

80
70
60
50
40
30
20
10
0

LOADING POINT

SPARKS, NEV.

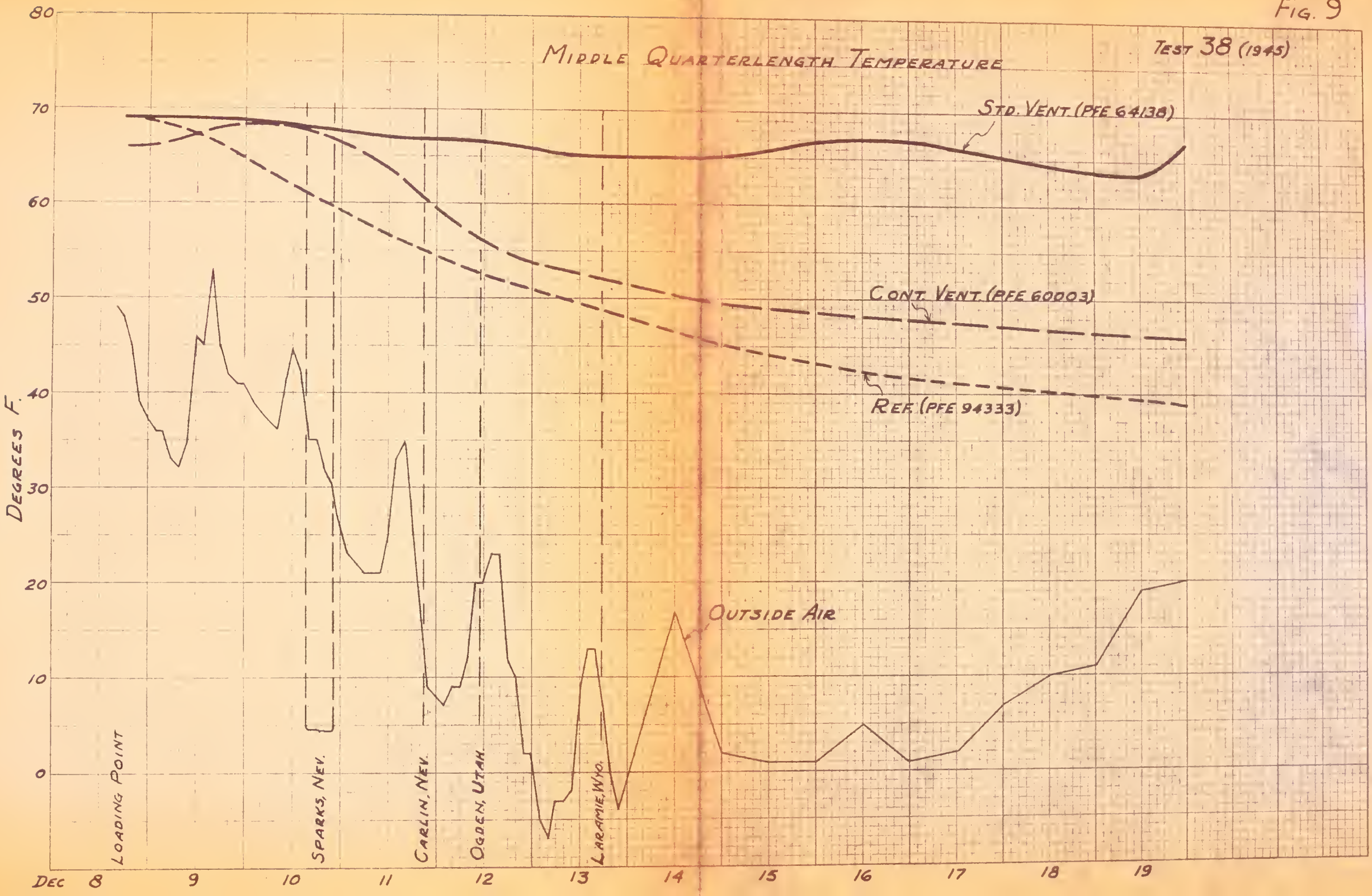
CARLIN, NEV.

OGDEN, UTAH.

LARAMIE, WYO.

DEC 6 7 8 9 10 11 12 13 14 15 16 17 18

FIG. 9

MIDDLE QUARTERLENGTH TEMPERATURE

TEST 38 (1945)